NEW HORIZONS OF INDUSTRY

THROUGH RESEARCH

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A TOUR THROUGH THE PRESENT INTO THE FUTURE

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OF
INDUSTRY
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A TOUR THROUGH THE PRESENT
INTO THE FUTURE

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The material in this booklet was compiled through the cooperation of a broad cross-section of the leading industrial and commercial organizations in the United States, and was first published upon the occasion of the "Highways to New Horizons" dinner dedicating the General Motors exhibit building at the New York World's Fair on April 19, 1939. The many requests for additional copies have made necessary this reprinting.

PREVIEW

RESEARCH and science pave a safe and bountiful highway to new horizons of industry. Since the General Motors Previews of Industrial Progress dinner at Chicago in 1934, industry has traveled five more years, swift, eventful.

To the heads of America's great corporations, I have put the question: "What is new? What is ahead along the industrial road?"

This is a highlight summary of industry, 1939 MODEL. Thanks to 107 great American institutions, we have a preview of approximately two hundred fifty products and processes in a multitude of fields.

We welcome the opportunity of correlating our experience and achievements with other industrial concerns. I believe that these results of industry demonstrate what can be done in the development of new products and the improvement of old ones, and thus get started to prosperous times through constructive work. I firmly believe that our efforts should be redoubled to speed up recovery and prove that industry's developments will bring tangible results in solving our problems.

Confident in American ability, reliant upon scientific guidance, grounded upon a bedrock of facts, industry will push on to new levels of achievement and progress—through research to new horizons.

ALFRED P. SLOAN, JR.

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TEXT WRITTEN AND CONTRIBUTIONS EDITED BY
WATSON DAVIS
Director, Science Service

AIR

Air-streamed speed. Wings over the prosaic earth. Miles become fractions of a minute. Young in years is mankind's airlife. Young in years, but saving years. Whirling propellers and sleek airfoils. Symbolic of our future. Solvent of our geography. Disturber of our complacency. Defender of our serenity.

Across land, across ocean, hedge-hopping, in troposphere. Engined wings purr us onward, demolishing time.

•

"The air transport industry provides new means of rapid transportation and communication that are linking the peoples of the world commercially, socially and politically," says *Eastern Air Lines'* President, EDWARD V. RICKENBACKER. "It is giving to the youth of this country opportunities never before offered as well as minimizing in this day the hazards of international conflict when the moral fabric of mankind is at its low ebb."

* * *

"In today's inspiring advance, aviation is playing a leading role. Its contribution to higher standard of living is universal and ever growing, its scope is unlimited," says DONALD W. DOUGLAS, President of *Douglas Aircraft Co., Inc.*

"It is the consensus of our engineering opinion that the outstanding contribution of the aeronautics industry to the science of living has been in the field of fluid mechanics. Researches in that field made possible recent developments in such widely separated subjects as the science of hydraulics, weather forecasting, the shapes and strength of our material surroundings and the speed with which man-made wings bridge and unify the faraway corners of the globe. Thus, the modern airplane—and the research that made it possible—has become one of the common denominators of industrial democracy."

* * *

"Technical progress and improved operating efficiency enabled airlines in the United States to set a world's record for safety and to establish a 1938 safety record 88 per cent better than 1937," observes W. A. Patterson, President, *United Airlines Transport Corporation.* This company holds the current National Safety Council safety award for technical advancement such as a terrain clearance indicator which records airplane elevation above actual terrain instead of above sea level, and a static suppressor which virtually eliminates plane radio static.

"New type feathering propellers are an important safety factor as they make possible complete stoppage of a propeller if an engine becomes disabled," adds Mr. Patterson. "Another milestone is the DC4 four-engined forty-passenger landplane by Douglas Aircraft Company in conjunction with five major airlines."

* * *

From *Boeing Airplane Company's* C. L. Egtvedt: "This company has developed four-motored airplanes for military and commercial uses. The military planes, on South American flights, have demonstrated effectiveness and reliability as defensive instruments. The clipper boats establish new standards of speed, comfort and capacity for transoceanic transport. Research now in process for development of high-altitude transport planes, with cabins designed to furnish atmospheric pressure for comfort of crew and passengers, gives promise of early progress to the point of commercial utilization."

* * *

New accomplishments, reported from *Curtiss-Wright Corporation* by its President, Guy W. Vaughan, "which promote safety and economy and have outstanding economic and social importance," include: "Anti-stall wings. Tell-tale instrument panel, for pilot aid and improved safety. Dynamic engine mount for vibration elimination. Reversible pitch propellers. Engines of higher performance, greater economy of operation and greater factors of safety. Curtiss-Wright CW-20 thirty-passenger transport now nearing completion incorporates most of these developments for improved safety and economy."

* * *

"Pleasing progress has been made on a broad front" by *North American Aviation, Inc.*, President J. H. Kindelberger speaking, "with improvements in construction methods, aerodynamic characteristics, safety, and military effectiveness. Our outstanding single achievement is development of new type light bomber faster than present planes and with exceptionally heavy armament and striking power.

Principal scientific development improvement in lateral control and control of stalling tendencies in monoplanes."

* * *

United Aircraft Corporation, according to President D. L. Brown, is developing "entirely new types of aircraft power plants of large output. These will enable military aircraft to attain superior performances and provide adequate power for super-bombers and giant boats. Their form is such that the ultimate in aerodynamic fineness and streamlining of airplanes may be secured, thus providing not only highest possible performance but maximum fuel economy."

* * *

To Jack Frye, President, *Transcontinental & Western Air, Incorporated*, the application of ultra-high radio frequencies to two-way communication between ground and aircraft is a major development.

"Five months of operational test of two-way communication equipment on 125,000 kilocycles between Pittsburgh and New York have just been completed by TWA in cooperation with Bell Telephone Laboratories," President Frye observes. "These frequencies provide perfect communication under intense thunderstorm and so-called precipitation static conditions. While economic and planning considerations will mean lapse of several years before this equipment will see general use, our opinion is that ultra-high radio frequencies as applied to two-way communication and aerial navigation will constitute one of the most important steps of recent years looking toward air transport operation completely unhindered by weather conditions."

* * *

"The recent trans-Atlantic flight of the American Clipper, the largest commercial passenger-carrying aircraft ever conceived," is to *Aluminum Company of America's* Chairman, Arthur V. Davis, "an example of aluminum helping to supply more efficient, economical and speedy transportation facilities."

* * *

President Vincent Bendix of *Bendix Aviation Corporation* reported: "First—a new aviation 'injection carburetor.' In this carburetor the fuel is sprayed into the engine supercharger under pressure rather than drawn into the chamber by suction as heretofore. Demonstrated advantages are improved atomization, marked saving in fuel, accurate automatic altitude adjustment, operation unaffected by plane position or military maneuvers, protection against vapor lock and freedom from carburetor ice formation.

"Second—new and broad development in aviation radio, in particular making possible, through so-called blind landing on radio beam, the safe landing of airships on ports so equipped under otherwise practically impossible weather conditions. Installation of proper equipment has already been completed in Burbank, Oakland, Chicago, Cleveland and Newark airports, and service through United Air Lines is expected to be inaugurated in those ports within a very few months."

* * *

The large aircraft engines now being built by one of *General Motors'* divisions may completely change high-speed and weight-carrying airplane design.

•

The future . . . ever more speed, crowding the heels of fleety sound? . . . 500 . . . 600 m.p.h.? . . . daily planes to Europe? . . . safe flight weather regardless? . . . little planes for you and me? . . . through research to new horizons.

CARS

Private transport. Much too good for royalty of old. MY private car. Millions of them, teeming broad highways. Leaving when you want to go. Comfortable as an armchair. Minding your slightest touch. Powerful beyond a giant's dreams. More speedy than anything on land or sea. The automobile, made in U.S.A.

Giant trucks. Fleet trucks. Busses full of children. Transport for our millions. Trackless trains. Freighters over hill and dale.

Steel, chemicals, fabrics, rubber, gasoline, and scores of other things. Mix with research, experience, skill and art. Roll along a production line and onto a highway.

●

In the automobile field, *General Motors Corporation* has made many additions and improvements to our motorcars, including the automatic transmission, hypoid gears, steel safety tops, coil spring suspensions and general increased performance, economy and safety.

* * *

"A method of transmitting power from the engine to the rear axle without the usual continuous mechanical connection," is reported by *Chrysler Corporation's* President, K. T. KELLER. This fluid drive is inserted between the flywheel and the crank shaft and operates on the same principles as centrifugal pumps and turbines. "Chrysler Corporation engineers are the first to develop this coupling so that it is practical for mass production."

"A new mechanical method of finishing metal of any shape or size so that in less than one minute surfaces can be made on which there are no scratches or marks more than a few millionths of an inch deep," is another development reported by Mr. Keller. "It not only makes commercially possible metal surfaces of optical flatness, but also surfaces on moving or mating parts of such smoothness that, when properly lubricated and with obvious reduction in friction, they will last almost indefinitely."

* * *

Armstrong Cork Company's President, H. W. PRENTIS, JR., mentions "special damping material to improve quiet and comfort of all-steel auto bodies."

* * *

A specially woven rubber-backed automobile carpet developed for the automotive industry by the *Thermoid Company*, according to F. E. SCHLUTER, President, meant use of looms "made idle when brake lining changed largely from woven to molded and created one hundred new jobs in our company."

* * *

Glass in fiber form "insulates high-tension wires for internal combustion engines" made by *Belden Manufacturing Company*, WHIPPLE JACOBS, President.

* * *

See also CHEMICALS, FARMS, GLASS, MACHINES, METALS, PETROLEUM, PLASTICS, ROADS and RUBBER.

•

The future . . . even more miles per gallon? . . . a car that parks itself in O space? . . . still greater margin of car safety over driver safety? . . . air-conditioned? . . . more fool-proofing against human weakness? . . . through research to new horizons.

CHEMICALS

C for carbon. H for hydrogen. O for oxygen. Coal. Wood. Oil. Gas. Water. Air. Common chemical elements. Common stuff. Riches beyond the dreams of Croesus. Substances nature never knew. New chemical bricks for our new civilization. A whole new spectrum of materials from sticky coal tar, from uninviting oil, from waste wood, from the very water we drink and the air we breathe. Even the food we eat.

In every industry. In every process. Every day and night. Chemistry creates. Chemistry rearranges our material life as it juggles molecules. New stuff for old.

•

"One of the outstanding events of the past year in the field of synthetic organic chemistry has been the development by the *Commercial Solvents Corporation* of the nitroparaffins. A group of chemical compounds entirely different from any which have been available before," says its President, THEODORE P. WALKER. "The manufacture of nitroparaffins has been the subject of intensive research for several years and these new chemical compounds will be available commercially in the near future. This development opens an entirely new field in industrial chemistry. Not only do the nitroparaffins offer prospects for the development of a wide range of new industries but they are also of interest because the basic raw material for their manufacture is natural gas, large quantities of which are being wasted today. Thus, this development of the nitroparaffins converts a waste material into industrial products of first-rate importance."

* * *

Edible fats from coal or petroleum are technically practical and synthetic glycerine from oil is commercially feasible, reports DANIEL PYZEL, Director, *Shell Oil Company.*

"Our synthesis of glycerine from propylene starts with chlorination at high temperature, resulting in substitution of chlorine in propylene to allyl chloride instead of addition to dichloropropane. Further conversion to glycerine of very high purity completely worked out and in operation in semi-commercial plant," says Mr. Pyzel. "As oxidation of paraffin-wax obtained by synthesis from water gas, to fatty acids now semi-commercially operated by IG. in Germany and synthesis of glycerides of these acids resulted in production of edible fatty oils, it is now possible to synthesize edible fats starting from coal or petroleum. Of course synthetic glycerine may be used for all well-known processes using natural glycerine, including production of glyptal resins."

* * *

"Beyond doubt commercial production of new products constantly being formulated in industry's laboratories will continue to result in higher standards of living for our people in the World of Tomorrow just as they have done in the past," in the opinion of THOMAS H. MCINNERNEY, President, *National Dairy Products Corporation.* "Our company is making steady progress in finding more commercial uses for skim milk and whey-derived by-products—notably lactic acid, calcium lactates and other metal lactates. Today derivatives of milk are used in the pharmaceutical, plastic, paper, dyeing, leather-tanning, carbonated beverage and other industries."

* * *

"Recent development of the large-scale production and shipment of elemental phosphorus is producing benefits of measurable economic and social value," says EDGAR MONSANTO QUEENY, President, *Monsanto Chemical Company.* "In cooperation with consuming industries Monsanto already has developed new phosphates to revolutionize household and commercial cleansing, permit the farmer to make hay while it rains, replace imported olive oil in the textile industry. This method of producing elemental phosphorus has made usable low-grade phosphate deposits and has trebled the availability of the Nation's phosphate resources and brought effectively nearer in time and distance the largest of the Nation's phosphate deposits."

* * *

After five years of pioneering success at mining the sea for bromine, EARLE W. WEBB, President of *Ethyl Gasoline Corporation* at Kure Beach, N. C., reports that "200,000 gallons of seawater are processed each minute to remove bromine in the ratio of one pound of bromine per ton of seawater. Chief use of bromine is as a constituent of anti-knock fluids containing tetraethyl lead but it is also used in photographic and medicinal industries, and it is important in national defense."

* * *

"Uses for citrus pectin have been developed in candy making and medicinally it has promising possibilities," reports President C. C. TEAGUE, *California Fruit Growers Exchange.* "From pectates come substances usable in steel quenching and creaming rubber latex. They are an excellent antistick material usable in manufacturing paper containers."

The future . . . raw coal burning almost a crime? . . . wood's lignin as precious as its cellulose? . . . farms producing industrial raw materials, not foods? . . . new industries where waste held sway? . . . through research to new horizons.

COMMUNICATION

Whispers outrun Puck around the world. Via wires. Via ether. Urgent. Immediate. Singing copper strands. Deep drowned cables. Invisible channels zigzagging from earth to heaven, to earth, to loud speakers. Telephone and telegraph. Cable. Radio. Electrons, swift messengers of mankind.

Sight joins sound. Television flashing around that corner. See as well as hear. The world before our eyes and ears. Bringing freely facts and emotions, war and peace, superstition and science, for evil and good.

●

"After more than 15 years of laboratory experiments and field tests, the radio industry presents television to the American public in 1939, commencing in the New York area in April," announces DAVID SARNOFF, President, *Radio Corporation of America.*

"Television represents a totally new art and industry which neither duplicates nor replaces anything heretofore in existence. It offers new avenues of public service, information and entertainment, and should eventually create new employment for thousands of workers in manufacturing and broadcasting. The practical realization of television this year is a signal contribution by American industrial research financed and supported by private enterprise. In its ultimate social effects, the public service of television should contribute both to our development as individuals and our solidarity as a Nation."

* * *

Facsimile, broadening "the entire field of record communication," is reported by NEWCOMB CARLTON, Chairman, *Western Union Telegraph Company.*

"A non-electrolytic substance, called teledeltos, has broad social and industrial effect. It can be made in many colors and is as sensitive to electricity as photographic film is to light. Permanent records may be made at high speed by passing an electric current through the medium, which requires no pretreatment or chemical process. This development is now being used for a number of facsimile purposes, and it is believed that the engineers have evolved a system so important, yet simple, that it will broaden the entire field of record communication."

* * *

"Early this year the *Crosley Corporation*," according to POWELL CROSLEY, JR., President, "introduced an entirely new development in radio—that of radio facsimile broadcasting (radio printing) together with a facsimile receiving set at a low cost, which makes it available to a mass market at prices comparable to those of popular-priced radio receivers. Reado, as we have named it, supplies a definite link between regular sound radio and television. Radio facsimile, we believe, will render a great service in many fields, civil and military. In the homes, the owner can pick up the printed record on arising in the morning, or at his convenience. In business, radio facsimile may be used for recording reports and information of timely importance. In military and naval aviation and motor transport service, it can be used to transmit map sketches and messages. In fact, any material that can be printed can be transmitted. The new field of radio facsimile broadcasting is introducing new vistas of radio usefulness. Its application doubtless has possibility even beyond our anticipation. As such it should open a new field of business and new employment opportunities."

•

The future . . . television as essential as the newspaper and radio? . . . conversations overseas limited to language rather than dollars? . . . pictures to the ends of the earth? . . . new radio through frequency modulation? . . . through research to new horizons.

FARMS

The soil. A mine of foodstuffs. Renewed annually by the sun's warmth, man's repayment of the minerals stolen by the crops, loving and conserving care in using. Back to earth. Basic, reassuring idea. Food, clothing, shelter from the earth.

Too much food. Embarrassment of abundance. Agricultural overproduction. Nature works one shift a year with no shutdowns, except disaster. Farms to feed factories as well as mouths. Raw materials from the soil. New machines for modern farms.

•

Announces President MAX W. BABB: "*Allis-Chalmers Manufacturing Company* introduces in 1939 a one-man operated harvesting machine that in a single operation cuts, threshes, separates, cleans and bins more than 100 different varieties of grains, beans and seeds ranging in size from the red kidney and baby lima beans down to bird seeds, at a labor cost of one man-hour per acre when harvesting commercial grains.

"The economic and social significance of this development is large because it makes low-cost, independent harvesting available for the small acreage farmer and it makes legumes, such as the clovers and the lespedezas, grown chiefly for soil building or feed in the past, give the farmer a cash return, as well as build his soil."

* * *

The most recent outstanding development of the *Minneapolis-Moline Power Implement Company*, according to W. S. PEDDIE, Treasurer, is "the comfortractor with an all-weather cab equipped with radio and heater, later to be air-conditioned. This to bring automobile comfort to the farmer in the operation of tractors."

* * *

"Better agricultural implements which can be sold for less money will enable the farmer to raise his crops with fewer man-hours of labor and therefore at less production cost," in the opinion of CHARLES DEERE WIMAN, President, *Deere & Company.*

* * *

"The whole of the farm equipment business is a contribution toward higher standards of living," in the opinion of LEON R. CLAUSEN, President, *J. I. Case Company.* "Our whole endeavor is to provide tools, machinery and power to do the tremendous job that must be done in plowing, preparing the soil, seeding, cultivating and harvesting the immense acreage of agricultural land in this country to take the hard job from the backs of the farmer, his sons and his hired help, and transfer it to machinery, to better the methods of soil preparation, fertilization, cultivation and harvesting the crops for better yields. All of this spells a higher standard of living on the farm, as well as relief from the hard, back-breaking labor of our forefathers.

"Furthermore, and most important of all, the farm machinery industry has released from the daily struggle for food the millions of workers who are required in our cities and other walks of life to provide or manufacture those things which are essential to a higher standard of living. In backward countries like China perhaps 85 per cent of the people are required to provide the food for the 100 per cent, just as we used to do in this country 100 years ago. Today 25 to 30 per cent of our people on the farm can better supply the food for the 100 per cent; the remaining 75 per cent of our workers can provide all the other things that go into the higher standard of American life, such as automobiles, radios, better homes, better equipment, better transportation and communication, better clothing, better amusement, better service, etc.

"We are constantly striving for improved machinery to continue the same process as described and, in addition, have developed new tools and machinery so as to spread the benefits of better methods to a greater variety of farms. For example: The small combine harvester, the small tractor now becoming highly developed, the tractor-mounted plows, cultivators, listers, planters, etc., which were a very recent development with tractor-drawn and tractor-mounted harvesting machinery, all of which make more efficient carrying on of the work."

* * *

New development of phosphates by *Monsanto Chemical Company,* President EDGAR MONSANTO QUEENY reveals, "permits the farmer to make hay while it rains."

* * *

Future developments in the plastics industry, in the opinion of GEORGE BAEKELAND, Vice-President, *Bakelite Corporation,* "will open up new outlets for farm products and thus play a part in the advancement of the American standard of living."

•

The future . . . crops bred and designed especially for industrial use? . . . soilless truck farms in giant bathtubs? . . . more machines and still less human toil on the soil? . . . through research to new horizons.

FIBERS

Cotton, wool, linen, silk. Standard fibers for centuries. Now new fibers. Man-made, beyond the skill of nature. Rayon, first chemical fiber creation. For years almost a chemical curiosity. Now millions of pounds a year, indispensable in clothing our millions.

Still newer fibers, hardly yet out of the laboratory. Fibers of new chemical compounds with long names. Better fibers. Fiber made from coal, air and water. Protein fiber, artificial wool made from milk. Threads of rubber. Even of glass. All made into cloth. Fabrics of a new age.

•

Says LAMMOT DU PONT, President, *E. I. du Pont de Nemours & Company:* "The latest and most important discovery coming from chemical research is Nylon, a wholly new organic material which is so versatile that the extent of its varied commercial uses can only be guessed today. Derived basically from coal, water and air, together with other materials, the textile filaments made from this product are stronger and more elastic than any fiber now in general use. The filaments can be drawn as fine as the spider's web.

"Nylon, first announced a few months ago, is being marketed now only in the limited quantity permitted by a pilot plant. It is being employed commercially for tooth brush purposes, sewing thread, fishing leaders and fishing lines. However, experimentally, it is lending itself gratifyingly to the making of fine hosiery and other knit goods, such as underwear; an increasing number of textile manufactures; gut for tennis rackets, and strings for musical instruments.

"In brushes, the filaments, replacing the old-time hog bristles, have long life, do not shed, are little affected by water, and retain their firmness. In hosiery, the material permits a high-twist yarn of pleasing luster and extreme sheerness.

"As concrete evidence of its confidence in the new product, the du Pont Company at the moment is constructing a plant at Seaford, Dela., costing more than $8,000,000, and enlarging its facilities at Belle, W. Va., at an expenditure of $2,000,000. The company expects to begin general commercial production of Nylon within the next year."

* * *

Other fibers are being perfected in laboratory and plant. Fibers from vinyl resins and from the casein of milk are nearing wide commercial distribution.

* * *

"Product of six years of research, the new continuous spinning machine for production of rayon yarns paves the way for woven fabrics of unprecedented quality and durability," according to H. S. Rivitz, President, *Industrial Rayon Corporation.*

"Conceived as an instrument necessary to attain ultimate uniformity in yarns for a wide variety of textiles, the new rayon machine converts fluid viscose into completely processed and twisted yarn, all in a single compact sequence instead of in many separate operations. It treats directly every filament of the most delicate yarns as they move forward in even, measured wraps around thread-advancing reels.

"Chemical-resistant plastics and molded hard rubber, advanced welding methods, record-breaking aluminum extrusions and modern transmission practices all played their parts in commercial development of this machine. It opens the door to comparable applications of the thread-advancing reel principle which will give manufacturers of thread, wire, narrow strip and similar materials the same accurate control over their products in compact, synchronized operation."

* * *

"Born of industrial research in depression years, glass in the form of strong, pliable fibers that can be felted and woven—even tied into knots—has, within the last few months, become a commercial reality," according to Harold Boeschenstein, President, *Owens-Corning Fiberglas Corporation.* "With many of the characteristics which have made glass, in heretofore known forms, indispensable in optical and scientific instruments, as containers for drugs and chemicals, and for protective and lighting purposes, Fiberglas is already making many contributions to safety, health and comfort as an air-filtering medium in homes, public buildings, factories and transportation equipment, and as efficient, long-lasting, lightweight insulation for buildings, trains, airplanes, busses, ships, refrigerators, stoves and for wide range of industrial needs. Its dielectric properties and high heat-resisting qualities make possible new standards of efficiency and design economy in electrical equipment, ranging from huge hydro-electric power generators to household appliances with smallest fractional horsepower motors.

"Fiberglas is being introduced at the World's Fair as fire-retarding textile fabric of great strength and life. It is too early to forecast ultimate utility in many fields. Application engineering by many industries has been important contributing factor to utilization of Fiberglas and demonstrates willingness of American business to support wholeheartedly new developments which advance human welfare. This new industry expects to afford steady employment and opportunity to increasing number of people."

* * *

"The textile industry for years has wanted a fine elastic yarn but it was not until our research and development laboratories produced a very fine rubber thread directly from the milk of the rubber tree that such a yarn was possible," advises ELMER ROBERTS, Vice-President, *United States Rubber Company.* "Lastex yarn is a product formed by covering this fine thread of rubber with cotton, silk or other material. It has become a style feature in women's footwear in the form of stretchable leather, as well as stretchable fabrics. It has entered as a style and comfort feature in men's shoes; in stylish swim suits it predominates this season's garments in almost every manufacturer's line.

"Fine yarns and fabrics have heretofore been possible only by using special types of asbestos, the supply of which is small. A new process for drafting and spinning asbestos which we have developed permits the manufacture of fine yarns of high strength from those forms of asbestos which are available in large amounts. This development opens up new fields where the heat and fire-resisting properties of asbestos are desirable, and where a fine structure is necessary."

* * *

"The development of a continuous process for the manufacture of rayon having usual qualities and at reduced cost for plant and per pound of product," is reported by EDWARD G. BUDD, President, *Edward G. Budd Manufacturing Company.*

●

The future . . . Nylon and Vinyon will put the silkworm on relief? . . . free American legs from foreign silk? . . . outmode spinning and looms by pouring fabrics like paper? . . . clothes so cheap it won't pay to launder? . . . through research to new horizons.

FOOD

Three squares a day. Breakfast. Lunch. Dinner. Meat. Bread. Vegetables. Fruits. Drink. Calories. Vitamins. Fats. Proteins. Carbohydrates. Plain and fancy foods. Foods from exotic lands, from home gardens, from thousand-acre farms. Fresh, frozen, canned, dried. Millions of tons of food. A ton of raw food materials each year for every man, woman or child.

Enough food. The right foods. Healthier, happier, more rational people. Better-looking men and women. A great industry servicing thousands of stores and millions of kitchens. Old foods. New foods. Processed for better taste, more nutritious quality, better value. Satisfying the prodigious appetite of the world.

•

Vitamins, added, created and cherished, are providing one of the most significant chapters in food history. Changing the dietary habits of consumers so that they drink large quantities of citrus juice rather than eat smaller amounts of fruit is *California Fruit Growers Exchange's* outstanding achievement, according to C. C. TEAGUE, President.

* * *

"Modern processing of foods has greatly reduced the Vitamin B_1 content of the American diets. Its restoration is of major importance," in the opinion of JOSEPH WILSHIRE, Chairman, *Standard Brands Incorporated.* "The Fleischmann Laboratories have discovered a procedure whereby ordinary yeast can be made to acquire greatly increased amounts of Vitamin B_1. This yeast is available to bakers for restoring to bread the Vitamin B_1 content of the original grain. The process is used in the preparation of Fleischmann's high vitamin yeast to supply additional vitamins to the diet and this special yeast lends itself to the production of high concentrations of this vitamin."

* * *

JAMES F. BELL, Chairman, *General Mills, Incorporated,* reports:

"Our joint enterprise with Eastman Kodak Company, carried on through Distillation Products, Incorporated, in the field of molecular distillation (useful in vitamin production), and in the development of diffusion pumps for high vacuum technique, gives promise of opening new doors for productive and profitable human effort."

* * *

"Meat has played an important part in the Nation's history, because it is America's most popular food and meat animals are the farmer's principal source of cash income," states *Swift & Company's* President, JOHN HOLMES. "We in the meat-packing industry have worked unceasingly to perfect our methods and to develop new and better products. As one example of recent progress, Swift & Company has developed a new ham. This development has made the ham more tender, still retaining flavor, and it has made it more economical for the housewife, by reducing the time and cost of cooking."

* * *

"The manufacture of Spam," a new *George A. Hormel & Company* product, according to A. A. DACEY, Director, "is based on a new process which produces a sterile product without overcooking, thus delivering to consumers, in a highly desirable form, certain cuts of meat which have heretofore been in secondary demand. The results achieved are a measurable increase in value of farmers' livestock, improvement in palatability and convenience of a food. As with other product developments, Spam has brought a substantial increase in employment."

* * *

"The general improvement of quality in foods, as well as increased sight, smell and taste appeal, is a general subject to which *Wilson & Company* has given a great deal of serious attention," according to EDWARD FOSS WILSON, President.

* * *

In the great industry of providing food in cans, control of the quality of the raw product is cited by FRANK E. GORRELL, *National Canners Association*, Secretary. An example is the use of a machine known as the tenderometer, which gauges the texture of peas and similar products. "A second course of progress," says Mr. Gorrell, "is control during canning operations, an example of which is improved heat-sterilization treatment of many products, especially fruit juices. The improvement of containers is also important, as in the use of cold reduction tin plate which reduces corrosion and in use of improved enamel can linings which protect appearance of product and container."

* * *

Quick frozen foods are emphasized by COLBY CHESTER, Chairman of Board, *General Foods Corporation.* "These new foods are fresh from gardens, ranges or the sea. Within a few hours they are stripped of waste, packed in sanitary cartons, and subjected to temperatures far below zero. Freshness, flavor and nutritional value are sealed into the food. More than 4,000 merchants and thousands of hotels, restaurants and institutions are outlets for these new products, and production and distribution are rapidly expanding. The consumer gets waste-free, time-saving, top-quality foods, ready to cook or serve. Birds Eye Frosted Foods have created part or full-time employment for thousands of workers in the past few years."

* * *

Protection and packaging of food are important. The *Westinghouse Electric and Manufacturing Company's* Sterilamp, reported by Chairman A. W. ROBERTSON, is making "the invisible rays of ultraviolet light perform such strangely diverse jobs as tenderizing tough cuts of meat, safeguarding the lives of patients undergoing operations and preserving foods. The first of these functions the Sterilamp performs by killing the mold on hanging meat so that under proper, carefully-controlled conditions, it can 'cure' rapidly without spoiling. As a sterilizing agent the lamp provides positive protection to all surfaces directly affected by its rays, and is now finding widespread use in food markets, restaurants and the like for preserving foods, sterilizing drinking glasses and utensils, and controlling bacteria and mold in a a variety of processes." (See also HEALTH.)

* * *

"Two notable new packages have recently been introduced," reports H. W. PHELPS, Chairman, *American Can Company.* "Beer cans involved long experiments and they offer many advantages to brewers, dealers and consumers. Fiber containers for fluid milk involved invention of intricate automatic machinery, scientific research and improvement in paper production. They offer a one-trip package, great improvement in bacteriological purity, reduction in weight and cost, to perhaps the greatest household and food necessity."

* * *

"A new method of preparing and shipping veal, one of the most delicate of meats," a *Swift & Company* development, "provides protection against practically all forms of contamination, sharply reduces shrinkage from packing house to consumer, improves flavor and tenderness, improves sales appeal, due to improved packaging methods, and as a by-product of the new packaging method provides for the utilization of huge quantities of cotton and paper bags."

•

The future . . . new foods with new taste thrills? . . . enough of the proper food for all? . . . synthetic food, built chemically from coal, air and water, freeing man from the soil? . . . through research to new horizons.

GLASS

Material of the ages. Since lightning struck sand. Earth made transparent. Providing windows to the sun. Utensils for the feast. Goblets for the thirsty. Glass. Colorless as air. Colored as the rainbow. Fragile as a thought. Tough almost as metal.

The metamorphosis of glass. Fine strands. Extruded as from an inanimate, mechanical spider. Spun into threads. Woven into cloth. New glass for a new world.

•

Transparent sandwiches—a new plastic between sheets of glass—give us new and better safety glass for auto windshields and windows, airplane glazing, mask goggles and other transparencies subject to hazardous breakage. The new Vinyl plastic is better than other plastics used before. Less danger from glass splinters are promised by this five-company cooperative achievement: *E. I. du Pont de Nemours & Company*, *Libbey-Owens-Ford Glass Co.*, *Pittsburgh Plate Glass Co.*, *Monsanto Chemical Co.*, and *Carbide and Carbon Chemicals Corporation.* This new automobile safety glass is used in a substantial percentage of 1939 cars and is available to all in 1940.

* * *

"Development of transparent or translucent heat insulation windows and outside walls represents one of *Pittsburgh Plate Glass Company's* latest achievements," which, according to H. S. WHERRETT, President, "is a contribution to air-conditioning, general comfort and economy in homes, commercial buildings, railroad cars and busses. The principle involved is a dead air cell between glass plates. One example is our one-cell double-glazed Pullman window with laminated safety plate glass on inside for passenger protection. Good vision is maintained with subzero outside temperatures. The heat loss factor is approximately 60 per cent of that of ordinary windows. The three-plate two-cell combination reduces heat transfer to 25 per cent."

* * *

Glass progress report from JOHN D. BIGGERS, President, *Libbey-Owens-Ford Glass Company:* "A new translucent glazing product, just going into production here, is composed of a layer of spun glass fibers sealed between two pieces of flat glass. It offers excellent light diffusion and effective insulation against heat, cold and sound. In Europe it is already being extensively used in factories and other buildings. A new load-bearing, glass-faced structural unit will make the aesthetic appeal of glass facing available for the entire exterior of buildings of practically any height and area. Glass blackboards relieve eyestrain in children and give better writing visibility from any angle."

* * *

"In an age of great progress in glass technology, *Corning Glass Works*' research in glass and glass-working equipment has made several contributions of outstanding importance to human welfare and industrial progress," according to AMORY HOUGHTON, President. "The 200-inch Palomar Mirror, the largest single piece of glass ever made, which will increase thirty-fold the present volume of the stellar universe; the glass boot for treating arterial diseases; glass for television bulbs; glass for insulin bottles; glass saucepans, skillets and teakettles for top-of-stove cooking; glass apparatus for distilling chaulmoogra oil for leprosy treatment. Research in glass machinery has greatly reduced costs and expanded use of radio tubes, incandescent lamps and common drinking tumblers. Corning research has also contributed in part to development of glass fibers for home insulation and textiles, and to glass bricks for building purposes. Through such research more people are employed here than at any time in the history of the company."

* * *

(For the invasion of glass into the domain of fibers and fabrics, see FIBERS.)

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The future . . . jewel-quality translucent blocks for man's temples and counting-houses? . . . Rare chemical elements competing with silica to make novel glasses? . . . new uses for glass fibers? . . . through research to new horizons.

HEALTH

Riches beyond avarice. A firm step, a light heart, a ruddy glow. Spring breezes. Sunshine. Clear gazing at the starry night. Being alive. Health.

Not up to par. Under the weather. Not feeling well. Illness. Doctor. Hospital. Chemicals against disease. Halting glands replaced by synthetic hormones. Vitamins to fight disease. Synthetic vitamins. Vaccines and serums. Defensive preparedness. Diseases that could be extinct. New ills, or ills newly recognized. Diseases untrammeled. Progress step by step. Life vs. death. Lengthening life span.

•

Chemical warfare against a great killer. GEORGE W. MERCK, President of *Merck & Company, Inc.*, advises: "Experimental studies published in May, 1938, demonstrated that a newly synthesized drug named 'Dagenan' (Sulfapyridine Merck) exerts a specific action against the pneumococcus, and subsequent clinical investigations determined its value in pneumococcic pneumonia. First prepared in the chemical research laboratories of May & Baker, Ltd., in England, this remarkable new drug has recently been made available to the medical profession in the United States by Merck & Company, Inc., which has contributed sufficient quantities to clinicians during the past eight months to treat approximately 15,000 cases of pneumonia. The dramatic clinical results obtained indicate that the development of this chemotherapeutic agent represents a major triumph of modern chemical research. Its economic and social significance is evidenced by the fact that pneumonia is exceeded only by heart disease and cancer as a principal cause of death in this country."

* * *

"Among historic developments in the pharmaceutical world was the discovery of Prontosil and related sulfanilamide compounds," says DR. W. E. WEISS, Director, *Winthrop Chemical Company, Inc.* "This pioneer discovery—made in an industrial laboratory—is of incalculable worth in terms of human welfare. Physicians have ably applied it in the rescue of lives threatened by the most grievous risk of motherhood, by serious complications of childhood diseases, by ravages of infections common in youth, by highly fatal pneumonias most prevalent in America. In the World of Tomorrow the pharmaceutical industry will collaborate even more fruitfully with the idealistic aim of the medical profession to safeguard health, relieve suffering and extend human life."

* * *

Wilson & Company, Inc., through its subsidiary, the *Wilson Laboratories*, "has made valuable contributions through the utilization of animal glandular derivatives to relieve human suffering. From the long list of products, we would mention our liver extract, used in the treatment of pernicious and secondary anemia, and adrenal cortex extract used in the treatment of Addison's disease and other adrenal insufficiency diseases."

* * *

A new anesthetic is reported by S. DEWITT CLOUGH, President, *Abbott Laboratories.* It is "Pentothal, a synthetic thiobarbiturate which is being extensively used to produce intravenous anesthesia for short operative procedures. Anesthesia under Pentothal is produced rapidly and pleasantly. Recovery is also without unpleasant symptoms. Consciousness is usually regained in from 10 to 15 minutes after injection of average dose. Ordinarily vomiting, headache or other distressing symptoms do not follow Pentothal administration.

"Vitamin K, used to prevent and stop bleeding by promoting blood clotting in connection with surgical operations of jaundiced patients who show a deficiency of this vitamin, was first made available by Abbott Laboratories (Klotogen). It is being used extensively with important favorable results in saving life and promoting convalescence."

* * *

In the medical armory presided over by President R. H. CABELL of *Armour & Company*, there are: "The Anti-Menorrhagic Factor, a new medicinal product from beef, hog and sheep livers, has a specific value in controlling certain forms of excessive functional bleeding.

"Yellow Bone Marrow Concentrate, derived from bone marrow of cattle, stimulates the production of white blood cells, and has been of outstanding value in treating Agranulocytosis, one of the most deadly diseases known.

"Polyansyn, from the anterior pituitary gland, which overcomes the total deficiency of the gland; Growth Complex, which promotes growth in stunted children; Gonadotropic Factor, which stimulates the growth and functional activity of the sex glands; and Lactogenic Factor, which stimulates the flow of milk after child-birth.

"Sterilizer control tubes, an entirely new device used to definitely tell the efficiency of heat sterilization. The color of the liquid contained in the tube changes from red to yellow to green when the sterilization temperature has been sufficient to destroy all organisms and spores.

"Neo-Fat, fractionated fatty acids, made from the distillation of whole fats."

* * *

General Electric Company has a new "gas insulated X-ray tube which permits more powerful X-ray equipment in greatly reduced space."

* * *

The Westinghouse Sterilamp (see also FOODS) "will destroy more than 85 per cent of the bacteria within its range, even when such organisms are flowing past it in the chambers of an air-conditioning system. Because of its low power consumption—about the same as a small Christmas tree lamp—it is economical to use, and its possibilities in the control of man's invisible enemies are almost impossible to estimate."

* * *

W. B. Bell, President, *American Cyanamid Co.*, states: "In our laboratories we produce a serum for every type of pneumonia. This treatment, particularly when coupled with sulfapyridine, which we also produce, promises the conquest of this dread disease. As suppliers of sulfanilamide, sulfapyridine and other organic chemicals, sera and vaccines, we have reason to believe great advances are at hand in the prevention and cure of other diseases."

•

The future . . . the great chemical panacea? . . . full use of what medical knowledge we have? . . . the cause and cure of cancer? . . . the postponement of old age? . . . through research to new horizons.

HOUSEHOLD

Better living with less work. Gadgets that become necessities. Flameless stoves. Iceless refrigerators. Rubless washing machines. Dustless dusting. Every woman's kitchen more nearly her workless shop.

Soapless detergents. Bristleless brushes. Burnable plates. Stainless knives. Dishragless dishwashers. Doors with electric eyes. Chiming door bells. Stoveside telephones. Applied science enters the home. To make living more pleasant.

•

"Latex foam sponge, a revolutionary development of *United States Rubber Company* laboratories," reported by ELMER ROBERTS, Vice-President, "has perhaps the greatest potentials for affecting the lives of over 130 millions of people during the next score of years than almost any conceivable product of industry. Potentially it involves the epochal improvement of every device upon which man sits or lies down. It represents the first major and radical change in cushioning since the invention of the spring itself.

"This revolutionary development involves the taking of the milk of the rubber tree, mixing it with other chemicals, whipping it into a foam, and then baking it in special molds to give it permanent shape and to produce a structure consisting of millions of interconnecting air cells. It is extremely light in weight, sanitary, self-ventilating and shape-holding through life; and its superior cushioning properties mark it as an epochal advance in industrial science.

"Latex foam sponge is rapidly being used to replace combinations of metal springs and hair and other materials for seat cushions and mattresses in railroads, airplanes, steamships, hospitals and homes. Using a smaller space than that occupied by the present upholstery materials and giving the rider a far better ride than he can secure in any other way, it is now being introduced in the automobile."

* * *

"Important to thousands living in the world of today as well as the World of Tomorrow is the Westinghouse Precipitron which electrically removes all dust from the air which passes between its charged plates," says Chairman A. W. Robertson of *Westinghouse Electric & Manufacturing Company.* "Fine dust particles invisible to the naked eye, such as those which make up cigarette smoke or hay fever-producing pollen, are caught by the Precipitron and held fast. In operation, a fan draws the air past an ionizing wire which emits a stream of electrons. Particles of dust suspended in the air flowing through this electrical stream become negatively charged. As the air continues through the machine it passes between a series of positively and negatively charged plates. Here the dust particles are drawn to the positive plates where they cling. Indispensable in any number of manufacturing processes where fine dust is a damaging factor, the Precipitron also has a brilliant future in providing dustless houses for housewives, complete relief for hay fever sufferers, and more healthful air for hospitals, stores and restaurants."

* * *

General Electric's new aids to the household, listed by President Gerard Swope, include: "The waste food Disposall, a low-cost sanitary labor-saving device that eliminates the garbage problems from the home, and the General Electric Blanket, for health and comfort."

* * *

In the air-conditioning and refrigeration field, *General Motors Corporation* has developed a commercial double-glass insulated window pane now in experimental production. The new line of refrigerants from a fluorine base has given an odorless and non-toxic material of many characteristics hitherto unattainable.

* * *

New phosphates to revolutionize household and commercial cleaning have been developed by *Monsanto Chemical Company.* (See CHEMICALS.)

* * *

A rubber-backed tufted cotton rug is a new product of the *Thermoid Company.*

●

The future . . . all-electrical houses? . . . summer air-cooling? . . . dustless and germless atmospheres? . . . through research to new horizons.

HOUSES

Caves. Brush huts. Skin tents. Log cabins. Stone houses. Frame dwellings. Brick residences. Castles. Palaces. Tenements. Apartment houses, cliff dwellings of a new age. Shelter. From the cold, the heat, the snow, the rain.

A place to eat, to sleep, to relax, to read, to listen to the radio, to rear the children, to entertain friends, to work at hobbies, to hang your hat. Four walls, a roof and a floor. A house. Home, sweet home. Houses for work. Factories. Offices. Buildings. The essential skeleton of our material culture.

●

"A celotex traffic top, a recent major development of *Celotex Corporation*," reported by BROR G. DAHLBERG, President, "makes usable acres and acres of previously unused flat roof and other surfaces subject to foot traffic and exposed to weather. It transforms them into useful playgrounds, recreation, sports and promenade areas. This product was developed from sugar cane fibers specially treated to increase rigidity, wear resistance, weather proofness and finish, providing resilient tile-like surface. It reduces cost of such roof treatments, offers structural advantages, creates work for more people, provides opportunity for open air and more sunshine in congested areas for children, adults and convalescents. It eliminates need for expensive urban ground space by utilizing waste flat roof space."

* * *

"Development of glazed ceramic granules has resulted in the introduction of a wide variety of fast colors to asphalt roofing industry at low cost," reports J. E. AUTEN, President, *Barber Asphalt Corporation.*

"It is no longer necessary to have concrete sub-floor under ceramic tile. Our new method and material permit laying tile right over old or new wood floors, affording owners of low-priced houses economy, beauty and sanitary advantages of tile."

* * *

"The resilient plastic composition used on many surfaces of the

New York World's Fair" is cited by *Armstrong Cork Company's* President, H. W. PRENTIS, JR.

* * *

"The introduction of asbestos-cement pipe for major economies in water transportation, sewerage systems and industrial uses, new asbestos-cement building materials for more permanent and economical construction of homes and commercial buildings, and rock wool home insulation," are listed by LEWIS H. BROWN, President, *Johns-Manville Corporation.* "One of the most significant contributions to home comfort in modern times, the practical use of rock wool for home insulation, was started by this company only 10 years ago and today it provides a livelihood for more than 2,000 men and their families in Johns-Manville and 45 competing companies."

* * *

"Architectural concrete buildings, in which both frame and exterior walls are of concrete," are reported by FRANK T. SHEETS, President, *Portland Cement Association.* "The concrete serves both structural and decorative functions, and is all cast in one-construction operation."

* * *

"Trukmixers, a product recently developed by the Construction Equipment Department of the *Blaw-Knox Company,*" in the opinion of CHESTER H. LEHMAN, Vice-Chairman of the Board, "have given many more men employment than in the past for the volume of concrete placed. This unit mixes the concrete in transit from a point of central charging to the destination."

* * *

"Pittsburgh, the city that gives the world standardized structural steel, now has become the birthplace of standard precast concrete shapes, which simplify fireproof construction and lower its cost through mass production," says W. P. WITHEROW, Chairman of the *Cementstone Corporation.*

"This has been revealed with the announcement of the organization of the Cemenstone Corporation, which will engage in the nationwide standardization of prefabricated concrete units, produced by newly patented principles of manufacture."

●

The future . . . houses factory-made, production-planned, assembled and sold like automobiles? . . . super-trailers, houses that can migrate with seasons? . . . new materials for houses, such as massive plastics? . . . through research to new horizons.

LIGHT

The full moon. Logs in flame and sparks flying high. Phosphorescence of decaying wood. Fagot torches. Stone lamps. Candles. Whale oil lamps. Kerosene lamps. Gas fishtail burners. Then electricity—arc, carbon filament in vacuum, tungsten in nitrogen, blue-green mercury vapor, red neon.

The night turned into day. Streets brilliant with light. The night a canvas for spectacles of illumination. The terror of darkness banished. Twenty-four hours out of every day—winter, spring, summer, autumn—emblazoned with light, from the sun or from man's creativeness.

•

New lamps for new nights are listed by GERARD SWOPE, President of *General Electric Company:* "The new highly efficient fluorescent lamp. The high intensity mercury lamp. The incandescent projector lamp which greatly enlarges the field of illumination. Sodium vapor lamps for more efficient and safe lighting of highways."

* * *

"Within the past year the electric incandescent filament lamps familiar for half a century have been seriously challenged by the new tubular fluorescent lamps using mercury vapor instead of tungsten wire," reports A. W. ROBERTSON, Chairman of *Westinghouse Electric & Manufacturing Company.* "By coating the inside of the lamp with various fluorescent materials, warm, glowing light in a variety of colors is produced. A 'daylight' fluorescent lamp produces a white light approaching natural daylight, much valued in manufacturing processes involving careful color work. Major benefits from fluorescent lighting are substantially more light per watt consumed and a quarter less heat in operation; this last being a valuable factor when used with air-conditioning equipment. Already in use in hundreds of public places, the fluorescent lamp is spectacularly visible at the New York World's Fair 1939."

* * *

"Better lighting facilities on railway cars have long been desired," explains F. N. BARD, President, *Barco Manufacturing Company.* "The difficulty has been due to the necessity of regulating lights through a carbon pile regulator, which absorbs an enormous amount of energy from the batteries that must be dissipated in heat. This method only regulates the voltage down.

"The new Barco voltage regulator efficiently regulates the voltage up or down from a primary battery, and maintains a constant light value for travelers, an entirely new principle. It will be useful in taking care of lighting load and air-conditioning load, and probably valuable in cold lighting from primary batteries and in airplane communication circuits."

•

The future . . . cold light, the secret of the firefly? . . . cities lighted by towering artificial suns? . . . through research to new horizons.

MACHINES

Wheels. Bearings. Gears. Traction. Metal on oil. Oil on metal. Output equals input less loss. Machines. Powerful. Silent if efficient. Noise means waste. The machine age. The power age.

Machines to make machines. To process power. To convert energy. To apply harnessed force to necessary tasks. Powerful machines. Mechanical power. Man makes machines. Do machines mold men?

●

"In the varied enterprises in which General Motors has engaged since the Chicago World's Fair," says ALFRED P. SLOAN, JR., Chairman, *General Motors Corporation*, "nothing so clearly illustrates the point we are making in this survey as what has happened in our Diesel engine development program. In five short years here is what has grown from research:

> "1. A modern Diesel locomotive plant near La Grange, Illinois. Fourteen acres of modern buildings and three miles of railroad track occupy 120 acres of former wind-swept prairie. Three thousand men have jobs that did not exist five years ago. The public rides comfortably, safely and luxuriously on 46 modern Diesel passenger trains that make schedules on both transcontinental and short-haul runs unheard of in 1934. Two hundred Diesel switching locomotives are cutting switching costs in half for some thirty-five American railroads.
>
> "2. Another modern plant has been built in Detroit to manufacture the same kind of two-cycle Diesel engines in smaller sizes applicable to stationary industrial power requirements and mobile needs such as in trucks, busses, tractors, steam shovels, portable power units and small cruisers. A research laboratory for the exclusive study of Diesel improvement has been built. Thus, 500 more new jobs have been created.
>
> "3. The former marine engine plant at Cleveland has been given new work converting large sizes of the two-cycle Diesel for wide marine application.

"4. Another General Motors plant in Cleveland, closed for several years, has been remodeled for the assembling of the small Diesels for use in industrial power units and truck and bus engine replacement units.

"All told, we have put an investment of $25,000,000 to work in our Diesel program. Some 4,000 new jobs have been created and the industry still is in its infancy."

* * *

"Six large high-lift pumping units for the Metropolitan Water District of California to pump water from Boulder Dam to Los Angeles," are cited by H. C. Beaver, President, *Worthington Pump and Machinery Corporation.* "Each of these units requires 12,500 hp. driving motor. This is the largest pumping installation of its kind in the world.

"Chief among several outstanding mechanical developments is our hydraulic decoking system designed to produce better-sized petroleum coke at much lower costs than now prevailing and eliminating hazard of accidents to employes.

"Our corporation plays a most important part in power plant installations for public utilities and industries in which we furnish large surface condensers, high-pressure and high-temperature boiler feed-pumping units, along with deaerating heaters and ejectors of new and greatly improved designs for highest operating economies.

"We are making numerous contributions in the furnishing of improved equipment to the oil and chemical industries for new processes recently developed. We have just completed an interesting development in a hydraulic transmission for which we expect a wide field of application in oil well drilling."

* * *

Conspicuous advances in the production of many kinds of light and heavy machinery by *Baldwin Locomotive Works*' subsidiaries are listed by Charles E. Brinley, Director: "From the testing machine of refined accuracy to the great turbine which transforms the power of our rivers into electricity for use in a thousand fields there may seem to be a broad range of accomplishment, yet in the Baldwin-Southwark shops you may see both of these machines with a multitude of others of intermediate sizes and for a variety of uses. On our floor today stands a great extrusion press ready for shipment, and many other presses all developed by our engineers specifically for individual duties specified by the customer."

* * *

"One of the more significant and consistent contributions to the economic welfare of the Nation and industrial progress," in the opinion of E. P. BULLARD, President, *The Bullard Co.*, "is the constant development in machine tools. It is a latent factor in the broader progress of all machinery of production. Its contributions are not spectacular or amazing, except to that clan (inoculated with machine oil) who bear responsibility of making more and better goods available at less cost to more people.

"Lower cost, therefore, brings greater production for wider distribution; also means ultimately more jobs for more people. Machinery's function removes the arduous burden, the longer hours at increasing living wage."

* * *

To the power and electric industries, *General Electric Company* is making new contributions, as listed by President GERARD SWOPE: "High-pressure, high-temperature steam turbines with hydrogen-cooled generators. Mercury vapor turbines, for greater economy and efficiency in electric power generation. A superior low-cost transformer 'Spirakore,' an important factor in economic rural electrification. The non-inflammable 'Pyranol' transformer, for safety in buildings and subways. Electronic tubes for the control and more efficient transmission of electric power. Oilless circuit breakers for electric power circuits. Mercury switch, containing high-pressure hydrogen, noiseless and with long life. A new insulated enameled wire, Formex, with heat, water and acid-resisting properties which will supersede present enameled wire. A fireproof insulation for cables, Flamenol."

* * *

"One of the most significant recent accomplishments from *Norton Company Laboratories* is a grinding wheel, the rim or face of which is made of crushed diamonds bonded with metal," says ALDUS C. HIGGINS, President. "Its principal use is for sharpening and cutting the cemented carbides, materials too hard to be ground economically with ordinary abrasive wheels. The diamond wheel is economically important because it makes possible a wider and more effective use of the cemented carbide cutting tools which are now considered indispensable in lowering machining costs."

* * *

"Materials combining insulating and refractory qualities," produced by *Armstrong Cork Company*, H. W. PRENTIS, JR., President, "have made possible use of higher temperatures in metallurgical and oil industries, thus helping to bring to consumer alloy steels, oils and gasoline at more acceptable prices. The same refractory products are important in national defense as they provide efficient boiler operation on battleships at great savings in weight."

* * *

Underwood Elliott Fisher Company's most significant accomplishment in the field of research and product development, summarized by L. C. Stowell, Executive Vice President, is "the recent completion of our general research laboratory at Hartford, Conn. In this laboratory every facility for research and scientific analysis is available to our engineering staff for perfecting our products and for applying new discoveries to their design and production. The economic and social importance of machines for typewriting and for bookkeeping is evident and we are resolved that our products will continue to make a real contribution to better living and greater employment through industrial progress."

•

The future . . . power in smaller packages . . . more automatic machinery for routine tasks? . . . machines to do routine thinking and planning? . . . through research to new horizons.

METALS

Iron and steel. Copper, zinc and tin. Aluminum, magnesium, beryllium. Nickel and chromium. Gold, silver, platinum. Tungsten, tantalum. Old metals. New metals. Precious metals. All useful metals.

The hot breath of blast furnaces, letting molten metallic blood. Super-mechanical robots, squeezing billets to peaceful sheeting or armor plate. A few per cent of this or that to harness red corrosion. Electro-veneer of uncorrupting stuff to banish the specter of rust. Mixtures of metals. Alloys. Metals more precious than gold because they pay dividends. Metals in abundance. Metals that must travel the sea routes. Metals for ships of land, sea and air. The iron age. The aluminum age. The age of metals.

•

"One of the most outstanding developments in the steel industry, to which all of the major sheet producers have contributed," according to EUGENE G. GRACE, President of *Bethlehem Steel Corporation*, "has been the development of high-quality, deep-drawn steel sheets which have made possible the fender and the all-steel top of the modern automobile. Each of the major steel companies has developed and placed on the market a commercial steel having high resistance to atmospheric corrosion and high tensile strength, thus permitting substantial savings in weight in structures where atmospheric corrosion is a major factor. Bethlehem's contribution in this field is Mayari R steel, which, in addition to having the properties recited above, is easily workable and safely weldable.

"Bethlehem Steel Corporation, either alone or in collaboration with others, has made the following developments:

"Apparatus for rapid determination of resistance of commercial steels to atmospheric corrosion which permits in a period of three months the prediction of the relative resistance of such steels at the end of many years' exposure to the atmosphere.

"The Bethanizing process of electrolytically zinc-coating wire is now being extended to sheets and Bethanized sheets will be placed on the market in the near future. These sheets have a zinc coating 99.99 per cent pure of any desired weight and possessing high ductility, which coating is applied at a rate 20 times the rate used in prior zinc electrolytic plating process." (See RAIL.)

* * *

"We in the steel industry, in the matter of method, have made great improvement in recent years through the development of better continuous rolling processes, which have greatly improved our products such as quality of sheets that allows manufacture of better automobiles, refrigerators, radios, and all the various articles that use this grade of steel," comments E. T. WEIR, Chairman, *National Steel Corporation.*

* * *

"Armco's principal contribution to the march of progress," in the opinion of CHARLES R. HOOK, President, *American Rolling Mill Co.*, "is the development of the continuous method of rolling sheet metal and wide strip. This method has been generally adopted by the steel industry and this development has made available products of greatly improved quality at lower cost and increased volume to fabricators of automobiles, stoves, washing machines, refrigerators, sanitary ware, and the myriads of products now classed as necessities by a large portion of our population.

"The continuous mill development has, in turn, paved the way for such special developments as Zincgrip sheet and strip, a galvanized-coated product which can be drawn and formed without peeling.

"It has made possible high-finish sheets of superior drawing properties for making deep stampings; electric sheets and strip of vastly improved magnetic quality; and sheets and strip for porcelain enameling of superior drawing and enameling properties.

"This technological development has greatly reduced the price of flat-rolled steel and products made of flat-rolled steel, at the same time producing marked improvement in quality. The broader market created thereby resulted in greatly increasing the total number of men required in the rolling and processing departments of the steel works, and the average hourly and annual earnings of these workers have been substantially increased.

"The contributions made by the steel industry to standards of living through spectacular new developments are probably of no greater importance than the sum of its steady contribution in improving and reducing costs of its standard products which the public are using constantly."

* * *

Republic Steel Corporation, T. M. GIRDLER, Chairman, has made "great advances in strip and sheet production by installing the largest continuous strip mill in the world, and greatly advanced the production of tin plate by the cold reduction process, as well as electro-galvanized wire, stainless steel, electric weld pipe, etc."

* * *

Youngstown Sheet and Tube Company, President FRANK PURNELL reports, has "a nickel-copper high-tensile steel which meets successfully the requirements of our modern high-speed age. Called Yoloy, it has a tensile strength up to 50 per cent greater than mild steels of the same carbon content. It is more ductile than ordinary steels of the same tensile strength. It has the same hardness as carbon steels of like tensile; it has excellent fatigue properties; possesses increased resistance to abrasions; has 20 per cent greater impact resistance than carbon steels of the same strength; has four to six times greater resistance to corrosion, and possesses admirable welding qualities. Since the use of Yoloy is indicated in numerous industries such as railroad, automotive, transportation, oil, fabricating, etc., its importance in our present social and economic era is pronounced."

* * *

"In the interest of social and economic progress," explains B. F. FAIRLESS, President, *United States Steel Corporation*, "the steel industry offers the recently developed high-strength steels, corrosion-resistant and workable-cold, making possible the production of lightweight moving equipment, busses, trucks, freight cars and the like. This paves the way for the realization of economies in operation amounting to millions of dollars annually. Similarly, the development of thin high-tensile stainless steel furnishes a new engineering material for the railroad and aviation industries, with profound and beneficial effect on design, performance and operating expense. New alloy steels for high-temperature service assist in attaining high efficiencies in steam power plants and provide efficient equipment for refining petroleum and for many processes in the chemical industry."

* * *

Recent contributions to the industry by *Campbell, Wyant & Cannon Foundry Company*, President D. J. CAMPBELL states, have been in "refinements in metallurgical processes for casting proferall crankshafts, camshafts, centrifuse brake drums and sleeves, and new alloyed steels.

"For control purposes in continuous pouring we have adapted spectrographic methods to replace the slower chemical analyses with gratifying results."

* * *

Inland Steel Company, according to PHILIP D. BLOCK, President, has found that "by the controlled addition of small quantities of lead, both carbon and alloy steels can be machined 30 to 50 per cent faster. The improvement in machinability is obtained without any sacrifice of other physical properties or interference in susceptibility to heat treatment. By reducing the cost of machining operations and making possible greater production, such steels have contributed to economic progress. Most of the large steel producers in the United States are licensed at a nominal royalty so as to make this development widely available. Large plants in England and France are now producing these steels and are enthusiastic in their reports of results obtained in the reduction of machining time and increased output."

* * *

"Amola, a fine-grained, alloy steel using in its manufacture, among other things, a definitely controlled ratio of molybdenum, silicon and aluminum," is reported by the *Chrysler Corporation*. "Not only has the formula for this new steel been developed by Chrysler Corporation engineers but also the method by which it is made.

"The development of Amola steel makes available to all manufacturers of mechanical units a higher-quality steel at lower cost than has heretofore been available. Its uses range from carburized gears, through axle shafts and springs to high-carbon razor blades as little as 5/1,000 of an inch in thickness."

Chrysler also reports "Oilite, an oil-filled, oil-cushion bronze, made of finely-powdered copper, tin and solid lubricants so processed that the finished product is a bronze of great strength and high lubricating value."

* * *

General Motors' metallurgical developments include new bearing materials of copper, lead, cadmium, silver and indium. A new quick-process malleable iron, which allows more use of malleable castings, has been developed. The adaptation of powdered metallurgy to productive problems opens up entirely new manufacturing techniques.

* * *

"A method of fabrication for large structures, using high alloyed steels, in which the high qualities are attained by means other than heat treatment," is the achievement of *Edward G. Budd Manufacturing Company*, President EDWARD G. BUDD states. "This technique has been applied to the building of railway cars, airplane structures, bridges and ships."

* * *

"Nickel's contribution to the greater convenience of mankind, through improved transportation, communications and industrial products, lies in its participation in the development of modern alloys," according to ROBERT C. STANLEY, President, *International Nickel Company of Canada, Ltd.* "With more than 2,200 separate nickel-bearing alloys, this contribution is spectacular in the variety and multiplicity of uses which research has found. Among the advances meriting special mention are the development of nickel alloy magnets of long life and great strength; of Inconel for important airplane parts encountering highly corrosive conditions and high temperatures; of stainless steels for streamline trains; and of heat-treatable non-ferrous alloys having the strength of alloy steels and possessing great corrosion resistance."

* * *

"The development of a commercially-successful process for concentrating low-grade manganese ore by the *Cuban-American Manganese Corporation*, a subsidiary of the *Freeport Sulphur Company*," is cited by LANGBOURNE M. WILLIAMS, JR., President, *Freeport Sulphur Company*.

"Since 14 pounds of manganese are essential in the making of an average ton of steel, manganese is more indispensable in this steel age than numerous substances more familiar to the layman. Yet, to date, the vast American deposits of low-grade manganese have been of slight value to the steel industry, which has imported more than 90 per cent of its requirements from foreign countries where high-grade manganese is found. Years of research and development work, involving the creation of equipment and the refinement of metallurgical processes, have had the result that the Cuban-American Manganese Corporation is in the position today, not merely to provide for the American steel industry manganese of suitably high grade at a price comparable with that quoted for foreign supplies, but to demonstrate the probability that engineering science can today make available the vast manganese deposits of this country if future necessities dictate this policy. It is estimated that more than enough manganese ore exists in this country to convert into steel all the known iron ore that the United States possesses. The proving of this process in Cuba, where success has been achieved in concentrating ores of low grade, foreshadows a day when the American steel industry will be as independent of foreign manganese supplies as it is of supplies of iron ore."

* * *

"One of the recent important contributions of *Fansteel Metallurgical Corporation* to industry," as expressed by R. J. AITCHISON, President, "comprises perfected practical tantalum heating, absorbing, condensing and cooling equipment for those industrial processes which employ hydrochloric and hydrobromic acid and bromine, thus making these difficult-to-handle reagents available for general industrial use at moderate cost and with complete reliability. One application is in connection with production of lead tetraethyl for ethyl gasoline. The perfection of metal radio tubes was made possible in large measure by use of our metal tantalum. Utilization of tantalum in television tubes promises material assistance in making this new development practical."

* * *

"It was only after years of testing by the Research Division of the *New Jersey Zinc Company*," according to MARSHALL L. HAVEY, General Sales Manager, "that the zinc alloys were developed which have made the economies of these alloys available to the die-casting industry. When the new high-purity alloys were established, the die casters carried on the research to improve die-casting technique. Today, zinc alloy die castings possess the accuracy, complexity, strength and economy which are serving so well to reduce the cost and improve the quality of essential metal parts. The advantages that zinc alloy die castings present in the manufacture of automobiles—and a host of other products—are contributing in no small way to the economic and social welfare of the American people—a direct result of industrial research."

* * *

"The latest major development of *Doehler Die Casting Company*," reported by H. H. DOEHLER, Chairman of Board, "is in the field of die-casting magnesium, now on a small production basis. Magnesium is the most plentiful metal on earth. It is destined to be the cheapest. It is one-fourth the weight of iron. Magnesium die castings are now used on Ford cars, textile machines, scientific instruments, portable machines, etc. The social and economic effect has been to reduce costs and weight of mechanical appliances, permitting greater distribution, greater production and greater employment."

* * *

New products developed by *Anaconda Copper Mining Company* are listed by C. F. KELLY, President: "Thin copper sheets in widths and lengths unobtainable by rolling are produced by electro-deposition. From these sheets a composite product is made by bonding them to a flexible backing such as building paper and asphaltic compounds, useful for weatherproofing and other purposes.

"By rolling composite ingots of silicon-copper and steel, there are produced bi-metal sheets combining strength of steel with corrosion resistance of copper. These are useful in industrial equipment and pipelines.

"By alloying with it approximately 2 per cent beryllium, copper when heat-treated has a strength and hardness exceeding many types of steel. It is used for springs and in the electrical industry.

"Indium, a rare metallic element, has recently been made available in commercial quantities. Corrosion of bearings can be reduced by plating them with indium."

* * *

A *General Electric* metallurgical development is "Alnico, providing permanent magnets twice as strong as any prior material."

* * *

"In spite of the fact that titanium is the ninth most plentiful element in the earth's crust," explains FLETCHER W. ROCKWELL, President, *National Lead Company*, "it was discovered only 150 years ago. Twenty years ago the development of titanium dioxide pigments was begun by a research group which grew into the Titanium Division of National Lead Company. This pigment now accounts for more than 60 per cent of the total hiding power of all white pigments produced. Research since 1934 has made its highly-concentrated opacity economical and indispensable in many products such as paper, rubber, ink, leather, cosmetics, plastics and paint coatings for houses, automobiles and refrigerators."

* * *

"In the past few years," according to N. W. RICE, President, *United States Smelting Refining and Mining Company*, "developments have revolutionized the handling of placer gravels in the far North where the ground is permanently frozen. This includes stripping large quantities of silty overburden and thawing the frozen gravels with cold water so they can be handled by the ordinary type of gold bucket dredge. This development has made it possible to employ a great many men in the far North and will contribute materially to the production of gold from frozen placer ground."

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The future . . . cheaper ways of unlocking light metals from earth? . . . a continuing procession of new steels? . . . new partnerships of metals to perform new tasks? . . . through research to new horizons.

PETROLEUM

Black gold. Oil. Petroleum. Liquid to burn. Fuel to run our motorcars. Power stuff for Diesels. Chemical raw material to build a thousand things we need. Oil gushing from the earth. Gas rushing from subterranean depths. Oil and gas flowing through long, black pipes, from well to refinery, from refinery to tank, from tank to filling station, to homes, to automobiles, to industry.

Common liquid this oil. Fluid sunshine of past ages. Billions of barrels of it. Fertilizing the nation with power. New in history, common in use. Oil, just oil. Just oil?

•

"The most important developments resulting from industrial research in the petroleum industry during the past three or four years," says ROBERT E. WILSON, *Pan American Petroleum & Transport Company's* President:

"Catalytic cracking (divorcing molecules with the aid of a non-participating chemical as judge) will undoubtedly play a very important factor in the future development of the oil industry and motorcars as well.

"High anti-knock gasoline from refinery gases by polymerization (fusing molecules to produce molecules of greater weight). This is even more important than catalytic cracking. It has greatly increased the amount of high anti-knock gasoline obtainable from a barrel of crude. There are two principal processes: catalytic and thermal.

"Liquid propane (C_3H_8) used as a refining agent in a wide variety of processes mainly in connection with the manufacture of lubricating oils." Versatile material this propane. Gas ordinarily, it is liquid at high pressures or low temperatures.

Tremendously increased speed, load-carrying and aviation engine efficiency in airplanes due to commercial manufacture of iso-octane aviation fuel. Pan American's President WILSON: "The ability of this country to make iso-octane cheaply in large quantities, to my mind, is as important from a military aviation standpoint as is our practical monopoly of helium for use of airships."

* * *

Oil's research roll of honor. For catalytic cracking: *Houdry Process Co., Sun Oil Co., Universal Oil Products Co., The M. W. Kellogg Co.* For catalytic polymerization: *Universal Oil Products Co.* For thermal polymerization: *Phillips Petroleum Co., Standard Oil Co.* (Indiana), *M. W. Kellogg Co., Standard Oil Co. of New Jersey.* For propane use: *Standard Oil Co.* (Indiana), *Union Oil Company.* For iso-octane: *Standard Oil Co. of New Jersey, Universal Oil Products Co., Shell Oil Co.*

* * *

Flaring waste. Gas from refineries burning brightly, unappreciated, mere fuel for stills. That was yesterday.

Refinery gas is now a treasured raw material for the chemical industry. Scores of processes and products, including the ultra motor fuels, are derived from refinery gas. Again President WILSON of Pan American: "The greatest discovery in the oil industry since the East Texas field is undoubtedly the discovery of the real value of refinery gas, available in their own back yards."

* * *

"Under the pressure of applied science brought to bear through industrial research, petroleum and natural gas are now becoming the starting point for limitless new synthetic industries," according to FRANK A. HOWARD, President, *Standard Oil Development Company.* "Standard Oil Company (New Jersey) interests have just put into operation two large plants which are examples of, and which pioneer, the new synthetic processes.

"At the Humble Oil and Refining Company, Baytown, Texas, a new plant is producing from byproduct gases 250,000 barrels a year of Alkylate. This is a synthetic super-fuel of great value when employed in the production of the 100-octane aviation gasoline required by advanced types of fighting planes.

"At the Standard Oil Company of Louisiana, Baton Rouge, there has been erected for the account of the Ethyl Gasoline Corporation a plant which produces, also from gas, 18,000,000 pounds per annum of ethyl chloride. This is an ethereal liquid chemical which is mostly employed in chemical manufacturing operations."

* * *

Fuel for airplanes that won't explode when crashes come. "Development of safety fuels is of special interest to commercial operation of airplanes," says D. L. BROWN, *United Aircraft Corporation's* President.

* * *

T. RIEBER, Chairman of the *Texas Company*, reports that "the Texas Company, Shell Union, Anglo-Iranian and Standard Oil of New Jersey have developed a new method of manufacturing motor fuel of high octane value. Petroleum gases are converted by catalytic alkylation with sulphuric acid catalyst directly into high anti-knock gasoline suitable as a fuel for airplanes. The potential supply of high octane aviation fuel from petroleum is thereby greatly increased and the cost reduced by elimination of expensive hydrogenation. This process is an outstanding achievement in the petroleum industry, insures an adequate supply of high octane aviation fuel for national defense and makes possible widespread increase in the development of commercial aviation. Because of its immediate importance, the process is being adopted by many refiners with unusual rapidity, and a number of new plants are now building."

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The future . . . edible fats from petroleum? . . . explosives from petroleum? . . . new drugs from petroleum? . . . any kind of fuel or lubricant from any kind of oil? . . . certainly better motor fuel . . . chemically tailored to order for powerful engines . . . through research to new horizons.

PLASTICS

Strange chemicals join to make a new material. Not wood, not metal, not clay, not cement. Plastics. Synthetic resins. Yet not resin. A new family of chemical materials. Great-grand-daddy of them all, youthful still, born of a union of two disinfectants: Carbolic acid and formaldehyde. Now from milk, water, air, coal, wood. From farm waste and other plentiful raw materials.

Material of a million uses. On auto dashes. Buttons. The buttons that switch on artificial suns. The cases of our boxes that talk and sing. Plastics, moldable to a million uses. Commercial plastics by the hundred. Lusty baby industry, growing fast.

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Eyeglasses, almost unbreakable, only half as heavy as conventional ones of glass. "A water-white resin for the first time provides a material of this character suitable for optical use," says ALDUS C. HIGGINS, President, *Norton Company*. "It is two to three times as hard as previous transparent resins which were not satisfactory because of lack of scratch resistance. It is so strong and tough that it is nearly unbreakable and when it is broken it does not shatter and produce slivers. This new material will find application because of the greater degree of safety against eye injury. Lenses of this type should find wide use for children, athletes and workers engaged in industries where the hazard of eye injury exists. Who dares to say what will be the ultimate extent of application affecting the lives of all of us?"

* * *

Wood welded with synthetic plastic. "Recently developed synthetic bonds for plywoods," in the opinion of GEORGE BAEKELAND, *Bakelite Corporation's* Vice-President, "contribute toward greater economy in construction of modern homes, airplanes, furniture, boats and parts of automobile bodies.

"New improvements in synthetic resins for paints and varnishes reduce drying time, thus cutting finishing costs. Added durability will result in considerable savings to manufacturers and consumers. Refinements in the processes for converting plastic materials into finished products mean better articles at lower costs. Latitude of design and range of colors in plastic materials have given new stimulus to many old established products."

* * *

The use of blood in plastics is an interesting new development reported by EDWARD FOSS WILSON, President, *Wilson & Company, Inc.*

* * *

The Plaskon Company, reports JAMES L. RODGERS, JR., President, "has recently developed urea formaldehyde adhesive, which may be pressed either hot or cold for the manufacture of plywood veneers and other general adhesive purposes. It has also developed urea formaldehyde resins suitable for incorporation in enamels for refrigerators, automobile finishes, etc. In molding powder field, outstanding development of urea resins has been in connection with illumination where this type of plastic offers distinct advantages as compared with glass."

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The future . . . new uses for plastics? . . . for houses, airplanes, automobiles? . . . spun finer than silk? . . . permanent as glass? . . . massive as concrete? . . . inexpensive as clay? . . . plastics from stuff now wasted? . . . through research to new horizons.

RAIL

Steel across the continent. Web of civilization. Prime mover of freight and mails. Towering meteors of iron and steam. Rushing day and night. On the minute like a fine watch. Traveling hotels, restaurants, luxurious private clubs. Air-conditioned. Miles for your pennies.

Streamlined trains symbolic of our modern age. The airplane lends its flair. Metallurgy gives new metals. Diesels give new power. More speed than ever before. Saving hours. Main arteries of lengthy transport.

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G. A. Blackmore, President, *Union Switch and Signal Company,* observes that "as the demand for higher railroad speed has increased, signaling has kept pace to remove serious delays and limitations to traffic handling. Through research, the Union Switch and Signal Company has contributed such major system developments as: electro-pneumatic and electric interlocking; car retarders for distribution of freight cars in classification yards; centralized traffic control, permitting a dispatcher to operate switches and signals by power over 100 or more miles of railroad, thus expediting traffic and permitting frequent non-stop train meets; route interlocking, providing for train routing in congested areas by simply pushing two-control panel buttons, one at each end of a designated route. These systems reduce operating costs and make possible present high-speed train operation with safety and economy."

* * *

"*The Westinghouse Air Brake Company,*" also according to President G. A. Blackmore, "through its extended research, has produced and developed new principles in the art of braking in the form of electro-pneumatic brakes and elements for protecting and controlling wheel adhesion not heretofore employed. These are applied to high-speed streamlined trains and street railway equipment, greatly contributing to the higher speeds of today in passenger movement.

"Similarly, advanced designs of air brake equipment for freight cars and locomotives have made it possible to increase speed, train length and capacity of freight transportation with increased economy and greatly improved safety, thus placing railway properties in position to operate with greater economy and dispatch than in the past."

* * *

"For over a hundred years, the *Baldwin Locomotive Works*," reports CHARLES E. BRINLEY, Director, "has been a leading constructor in the field of steam motive power for railroads and has been conspicuous in the development of the fast, high-powered, modern steam locomotive. Though this modern locomotive may be said to be the result of an evolution rather than of the establishment of a new industry, nevertheless this evolution has produced a machine so far in advance of that of even a few years ago as to have contributed substantially to the development of our national industrial economy. In the Diesel field also the Baldwin Company is prepared to take its place and accepts the responsibility of making its own contribution to this type of motive power. Progress and research in the last 100 years have made America industrially great and have created America's high standard of living for all. And progress in America has only just begun!"

* * *

The process of controlled cooling of rails, developed by *Bethlehem Steel Corporation* and made available to all rail manufacturers in the United States, "gives almost complete assurance against an extremely dangerous type of rail failure known as the transverse fissure, which was heretofore frequently encountered in service."

* * *

A *Portland Cement Association* development is "concrete subballast slab for railway track support, produced by cement grouting railway ballast or by precasting concrete slabs. This serves to bridge over soft sub-grade, distribute loads, and insure smooth riding track at lowered maintenance cost."

* * *

"During the past century the great development of this country has been largely due to our railroad transportation system," says WILLIAM C. DICKERMAN, President, *American Locomotive Company*. "The prosperity of the railroads is vital to the prosperity of the country as this industry is directly responsible for the livelihood of a million families and indirectly, through their purchases of supplies and equipment amounting in normal times to more than a billion dollars a year, giving employment to many more. Any assistance given the railroads in reducing operating costs brings them that nearer to prosperity.

"Our contribution in recent product development has included the designing and building of new motive power units, effecting great savings in operation due to much higher availability, lower maintenance and fuel costs, and decreased transportation expenses. Among these are 20 Union Pacific high-speed passenger locomotives, showing net annual saving on investment of 50 per cent; Milwaukee high-speed passenger locomotives, showing 100 per cent. We are also contributors to design of new high-speed, high-power streamlined locomotive at the Fair, built by Pennsylvania Railroad."

* * *

"In the field of railroad passenger transportation there have been developed and widely applied systems of air-conditioning that have greatly improved the conditions of comfort, cleanliness and quiet in rail travel," states D. A. CRAWFORD, President of *Pullman Company*. "There have also been developed new materials and new fabricating methods for the construction of lightweight equipment, both passenger and freight, that together with improved motive power have made possible safe high-speed operation. This has contributed largely to the competitive efficiency of rail transportation. New and improved types of sleeping car accommodations have been developed and widely installed in service, adding largely to the convenience and comfort of travel by rail."

* * *

General Motors states: "In five short years here is what has grown from research in the railroad field alone: A modern Diesel locomotive plant near La Grange, Illinois. Fourteen acres of modern buildings and three miles of railroad track occupy 120 acres of former windswept prairie. Three thousand men have jobs that did not exist five years ago. The public rides comfortably, safely and luxuriously on 46 modern Diesel passenger trains that make schedules on both transcontinental and short-haul runs unheard of in 1934. Two hundred Diesel switching locomotives are cutting switching costs in half for some thirty-five American railroads." See also MACHINERY.

* * *

High-powered steam turbine electric locomotives for railroads constitute a *General Electric Company* contribution to rail progress.

* * *

The new train of the Brooklyn-Manhattan Transit Company is an example of aluminum's use cited by ARTHUR V. DAVIS, Chairman of the *Aluminum Company of America.* "Airplanes and such cars embody within and without new aluminum alloys, there combined to form today's revolution in transportation. These alloys have been developed to serve all industry by our carefully-planned program of aluminum research."

* * *

"Design of a railway truck which gives smoother running, quieter operation, reduces the weight and greatly reduces the maintenance cost, and design of a new brake for railway cars" are among *Edward G. Budd Manufacturing Company's* achievements. See also METALS.

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The future . . . more frequent schedules with shorter, lighter trains? . . . older puffing engines for freight only? . . . steam turbine locomotives? . . . through research to new horizons.

ROADS

Cowpaths. Trails. One-track, muddy lanes. Stage roads. Toll gates. The horseless carriage. Bad roads intolerable. Brick. Macadam. Concrete. Bitumen. Hard, all-weather ribbons, tying populations together. Automotive highways of progress.

Two, four, six lanes. Pleasant parkways separating the going and the coming. One road for north, another for south. Red, amber, green lights. Curves banked for sixty. Speed with safety. Safety first. Highways to more living in fewer hours.

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"The *Portland Cement Association* after three years' basic research has developed soil-cement roads, the new answer to the light-traffic road problem," according to Frank T. Sheets, President. "Extensive laboratory research has developed the basic principles of combining natural roadway soil and Portland Cement, to produce durable, weather-resisting material at low cost for light-traffic roads. Scientific tests in laboratory predetermine the amount of cement, moisture and density required for a particular soil to insure durability under wetting, drying, freezing, thawing and weathering conditions encountered in the field. Good engineering control on the job is essential, as laboratory findings must be applied in construction. But, although scientific, both laboratory and construction procedure is simple.

"The following is a brief summary of construction methods: Existing soil or old roadway is scarified and pulverized to a depth of about six inches. A carefully-predetermined amount of Portland Cement is spread over the soil and then mixed in with field cultivators, gang plows or harrows, or other suitable equipment. The proper amount of water is added, and the mixture is compacted from the bottom with sheep's-foot rollers to required density, struck off to crown and grade, and ironed out with heavy smooth rollers. The surface is then protected for a short period with damp straw, hay or earth.

"Experience on 50 jobs throughout the country, totaling 150 miles, has demonstrated that this construction is practical, durable, low in cost, and that simple, readily available equipment may be used. Soil-cement roads should not be confused with Portland cement-concreted roads. They are not intended for heavy-duty service, where concrete is both superior and essential. But soil-cement does offer durable and strong material in the low-cost, light-traffic field. Soil-cement mixtures are also useful for airport runways, park drives, residential streets, tennis courts, ditch linings, earth dams and adobe-type building blocks."

* * *

J. E. AUTEN, President, *Barber Asphalt Corporation*, reports: "Our company has played an important part in supplying construction materials for highways to present horizons. We have come through again in development of a method of curing concrete at lower cost, giving greater strength, permitting smaller cross-section areas. Such highways wear longer and produce much less glare."

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The future . . . every country lane an all-year auto highway? . . . super-highways avoiding cities for speeding through travel? . . . roads as modernized as the autos that use them? . . . through research to new horizons.

RUBBER

Civilization's cushion. Material that punches back. Elasticity embodied. Snappy stuff. Liaison between road and automobile. Tougher than steel to wear. Juice of a tropical tree that filters into every corner of our daily life.

Padding for human spines. Non-metallic springs for transport. Raw material for new materials. Hard rubber. Sponge rubber. Catholic collaborator with other things. As fibers, cloths, metals. One of our prime essentials. Essential in war as in peace.

•

"*B. F. Goodrich Rubber Company* will smooth the highways to new horizons with rubber-sealing strips, insure quiet and safety with non-slip tires and rubber torsilastic springs," S. B. ROBERTSON, President, reports. "Our long record of contributions to safety and comfort embraces also fibro insulators for street cars and factory machinery, rubber tracks for high-speed tractors, rubber haircushions for furniture and vehicles, de-icers for airplanes. Supplementing our pioneering of rubber-lined equipment for mechanical operations, Koroseal, plasticized vinyl polymer, offers unique resistance to powerful oxidizing solutions. Its mechanical stability, flexibility and non-flammability adapt Koroseal for electrical installation, weatherproof fabrics and packages, and coatings protecting pipe against soil corrosion. May we continue in the World of Tomorrow to utilize rubber or rubberlike synthetics increasingly for the service of the Nation!"

* * *

"During depression years activity in the field of research has been especially intense," according to P. W. LITCHFIELD, President, *Goodyear Tire & Rubber Company.* "Arising out of this activity come new products and innovations of impressive value and service to the public. Uppermost on our list is the Goodyear Lifeguard, which consists of a tire within a tire. On the reserve air chamber thus provided, an automobile may be driven to a safe stop even after the most severe blowout. The saving of life and property is the primary function of this product, which we rank along with four-wheel brakes, safety steel bodies and shatterproof glass as an outstanding contribution to the cause of safe motoring.

"Another of our newest developments is Pliofilm. This is a tough, thin, transparent, waterproof sheet of rubber which is already finding scores of uses. The significance of Pliofilm extends far beyond employment in the factory which makes it. It creates new markets for other manufacturers and retailers, and increases saleability of existing merchandise, including everything from wearing apparel to foodstuffs. It serves the public by better protection and preservation of foods.

"Another innovation is our Airfoam, a beaten and molded latex product, which offers superior cushioning qualities for automobile seats, furniture upholstering and mattresses. The potential field for this material is vast since it contributes so much to the safety and comfort of the public."

* * *

United States Rubber Company, through Vice-President ELMER ROBERTS, comments: "The continuous development of improvements in automobile tires has made the high-speed automobile possible with more comfortable riding at very much smaller mileage cost. When, however, we pioneered the development of the Royal Master tire with its true non-skidding and quick-stop performance, the ultimate safety factor long sought in cars was achieved.

"Unlike the ordinary sponge or the revolutionary foam sponge (see HOUSEHOLD) which has interconnecting cells, the cellular hard rubber mass consists of an enormous number of non-interconnecting cells. This characteristic makes it a highly efficient thermal insulation. It is waterproof and vaporproof. Older materials permit an interior condensation of moisture and hence rapid loss of insulating value. The new cellular hard rubber, because of its non-interconnecting cells, retains the high insulating value for a much longer period. While it is extremely light—as low as 4.25 pounds per cubic foot—it is sufficiently strong and rigid to have a structural value and can be either used in pre-shaped form or fashioned in a manner similar to wood. These characteristics make it the latest aid in the thermal insulating field, particularly for refrigeration, with striking possibilities in home and automobile insulation.

"By an entirely different process than those used in the production of latex foam sponge or cellular hard rubber, a new type of rubber sheet having a high degree of porosity has been produced. The size of the pores can be varied over a considerable range. These microporous rubber products are highly resistant to corrosion. One form of the material is now being used extensively in the manufacture of storage batteries. Other forms will have important applications in other fields, particularly that of filtration." (See also FIBERS.)

* * *

"Significant of its extensive research and development activities," reports Harvey S. Firestone, Jr., Chairman, "*Firestone Tire & Rubber Co.* has introduced a host of new and diversified rubber and latex products, each opening a new avenue to industrial and economic progress.

"Airtex, a new aerated latex material, signalizes a new era in upholstering and in mattress manufacturing by providing comfort, sanitation and durability heretofore unattained.

"Development of the multiple injection process of molding plastic articles of large size has increased immeasurably the scope of the utility of plastics. New fields of application include automobile parts, household furnishings and office equipment.

"An interesting new development in the automotive field is the Firestone airspring, which makes it possible for the first time to cradle the motorcar entirely on air.

"Additional developments include Everlastic, a new rubber yarn for clothing, rubber vibration isolaters to counteract vibration in mechanical equipment, and rubber tie plates for installation between ties and rails to muffle the noise and roar of railway cars.

"All of these Firestone developments are directly influential in providing new employment and contributing to new standards of economic and social welfare."

◆

The future . . . chemical duplication of natural rubber to break overseas monopoly? . . . more use of artificial rubberlike substances? . . . through research to new horizons.

VISION

Aids to feeble human eyes. Lenses. Sensitive silver in gelatin. Mechanical, chemical eyes that capture light too long, too short for seeing. Heat light, black light.

Century-old photography blossoming in color. Electricity writing pictures. Light painting the spot sight of today. Everyone a movie star. Everyone a photographic artist. Faster, faster, faster. Keener camera eyes. Keener emulsion memories. Flying cameras. Whole counties in one shutter wink. Work or play.

•

"Extreme speed photographic films first developed in *Agfa Ansco Corporation* laboratories in Binghamton, New York, as the result of an entirely new method of photographic emulsion manufacture," are cited by ERNST SCHWARZ, President. "These films, about four times faster than any films previously made, offer increasing possibilities of photography in many important fields. They make possible the presentation in newspapers and news reels of news events which through adverse light conditions could not heretofore be photographed. The high speed of these films widens picture-taking possibilities with inexpensive cameras. Used in connection with high-speed lenses, these films have opened up almost unlimited fields of photography under lighting conditions heretofore considered impossible. The importance of this new invention for the motion picture industry has been recognized by the Academy of Motion Picture Arts and Sciences in awarding to Agfa Ansco Corporation the Golden Statuette as highest honor for the development of these films."

* * *

Eastman Kodak Company's Vice-President, A. F. SULZER, comments: "It was a wonderful world General Motors depicted at its memorable dinner in 1934, but it was a world in black and white; for photography, the recorder could reproduce color only by processes too difficult for common use.

"In the five years past the most important photographic change has occurred since the introduction of transparent film by George

Eastman in 1889. The Kodachrome process has put color at the command of amateur photographers. With comparable significance, Kodachrome is serving the professional photographers, thereby affecting the quality of the advertising illustrations that sell 1939's products.

"So important is this development for the photographic World of Tomorrow that a panorama of ever-changing color scenes has been made the central feature of Kodak's contribution to the Fair."

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"An outstanding *Bausch & Lomb Optical Co.* contribution, "according to President M. H. Eisenhart, "is the multiplex projector, an apparatus for projectioning stereoscopically aerial photographs in such a way that contour topographic maps can be made with much greater speed than with ground surveys. Their use has made possible rapid progress in furnishing much-needed maps for flood control and soil conservation work by Government agencies. Radical advancement in this work, so vital to the agricultural, forestry and power interests, will take place during the next decade because of the possibilities opened by this recently developed instrument."

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Invisible or non-reflecting glass developed in *General Electric's* research laboratories promises to come out of the laboratory in the near future, increasing the transmission of light through photographic lenses, making reflectionless show windows, etc.

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For television and facsimile, see COMMUNICATION.

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The future . . . color a commonplace in amateur snapshots? . . . polarized light put to work? . . . less expensive cameras through molded plastic lenses? . . . facsimile as common as telegrams? . . . through research to new horizons.

WOOD

Simplest building material. Logs. Sawed lumber. Now processed wood material, chemically treated against damage and decay. From the trunk of the tree: Shelter, clothing, furniture, paper, plastics, chemicals such as methanol and rosin, sugar as from the maple, cattle food through chemistry, etc.

Old-fashioned wood. Modern wood. Six-by-sixes for strength. Paper thin veneer for beauty. Logs for a blazing hearth. Sawdust to waste and burn. Wooden Indians. Wooden nickels. Wooden expressions. Wooden underpinnings for important activities in a modern world.

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"*The Masonite Corporation* is about ready to bring into manufacture a low-cost plastic, the scope of uses for which seems unlimited," according to R. G. WALLACE, Vice-President. "Valuable chemicals will be synthesized from wood. These new products, when in commercial production, will add to the wage and salaried employes of our company, thus confirming our conviction that research and inventive genius offer the sure way to eliminate unemployment."

* * *

EDGAR MONSANTO QUEENY, President, *Monsanto Chemical Company*, announces: "Pentachlorophenol, or santobrite, for wood treatment and preservation has a tremendous economic significance because it will stabilize the lumber industry and enable it to compete on a more favorable footing with steel, plastics, cement and other competitive materials, thus protecting the livelihood of hundreds of thousands of persons."

* * *

"In the paper industry one of the outstanding developments is that of the *Mead Corporation* in the promotion and successful manufacture of high-quality corrugating board for shipping containers from waste chestnut chips," according to C. R. VAN DE CARR, JR., Vice-President.

"This material, formerly discarded in the tanning extract industry as worthless, is now converted into a leading product valued at several million dollars annually, contributing an entirely new source of employment and a living for thousands in the middle South. The operation owes its existence and success entirely to research and technical skill, as it was developed on the basis of a new process never before used in manufacturing."

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The future . . . lignin the most valuable part of wood? . . . forests of 1960, 1980 and 2000 planted today? . . . use of untreated wood an industrial crime? . . . through research to new horizons.